HORIZONTAL DRILLING OPERATIONS

PLANNING, TOOLS AND FIELD PRACTICE

Instructor: Dr. Marc Haci

Duration	5 days, customizable
Level	All
Audience	Drilling Engineers and Geoscientists
Format	Classroom Instruction

Summary

Horizontal wells are now the standard way to develop conventional and unconventional reservoirs. Drilling them safely and economically takes more than conventional directional-drilling know-how. This course gives a practical, field-oriented foundation in how horizontal wells are planned, steered and delivered, from the geometry of the well path to the downhole tools that build the curve and the procedures used to land the well in the target and keep the lateral in the pay zone.

The course starts with the development of directional drilling, the main well types and their applications, the latest well designs, and the technical limits of directional drilling. It then covers well planning and trajectory calculations: surveying, directional trajectory methods, azimuth reference systems and magnetic interference, torque and drag, friction factors and how to reduce them, buckling, weight definitions and hydraulics in horizontal wells.

Participants then study the tools that make horizontal drilling possible: MWD/LWD sensor packages and telemetry, downhole motors and their performance curves, motor and bent-housing selection, steerable, non-steerable and rotary steerable assemblies, drill strings designed for horizontal drilling, and bits.

The final part follows a horizontal well through its operations: kick-off in new drill wells and re-entries, casing exits, building and landing the curve, magnetic and gravity tool-face steering, projections to the bit and the target, geosteering the lateral, and sidetracking. Worked examples and calculations throughout the course connect the theory to decisions made at the rig site.

About the Instructor

Dr. Marc Haci is a drilling engineer and entrepreneur with more than 30 years in the drilling industry, most of them in directional and horizontal drilling. At Drilling Measurements Inc. (1994–2000) he planned directional and horizontal wells and supervised drilling operations, then served as VP of Directional Drilling Services, responsible for the company's directional drilling and MWD business. He went on to launch Welltec's U.S. downhole-tractor operations. As Senior Drilling Advisor at Noble Drilling, he led the development and field testing of Slider, an automated slide-drilling system for steerable motors. In 2004 he co-founded Slider LLC, and he remained VP Operations after the business was acquired by Smith International and later Schlumberger. In 2014 he founded WellFence, a credentialed wellsite-access company that Drilling Tools International (DTI) acquired in 2019. At DTI he served as Executive VP, Data Automation Technology, and then as Chief Technology Officer. He is now President of Must Holding. Dr. Haci holds MS and PhD degrees in petroleum engineering from Louisiana State University. He was a postdoctoral researcher at IFP Energies Nouvelles and an Assistant Professor at Istanbul Technical University. His papers on eccentric-annulus hydraulics, horizontal-well pressure behavior and productivity, and torque in slide drilling, together with his directional-drilling patents, have been cited more than 1,500 times.

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Learning Outcomes

Participants will:

1. Understand how directional and horizontal drilling developed, the main well types and their applications, and the technical limits of today's wells.
2. Plan horizontal well trajectories, perform survey calculations, and apply azimuth reference systems while accounting for magnetic interference.
3. Estimate torque, drag and buckling in horizontal wells, and apply practices that reduce friction and improve weight transfer to the bit.
4. Evaluate MWD/LWD guidance systems and telemetry options on operational and economic criteria.
5. Select downhole motors and bent-housing settings, steerable or rotary steerable assemblies, drill strings and bits for a given well plan.
6. Follow the operational sequence of a horizontal well: kick-off or casing exit, building and landing the curve, tool-face control, and geosteering the lateral. Recognize when and how to sidetrack.

Duration and Training Method

A 5-day classroom course with lectures, worked calculation examples, and discussion of field cases. Exercises cover well planning, torque and drag, motor selection, and building and landing the curve, so participants apply each topic as it is taught.

Who Should Attend

This course is for drilling engineers, rig-site supervisors, and geoscientists involved in planning or geosteering horizontal wells. Asset managers and reservoir engineers who need a working understanding of how horizontal wells are drilled will also find it useful.

Prerequisites and Linking Courses

General familiarity with oilfield drilling operations and terminology is helpful but not required. The course reviews the fundamentals before moving on to horizontal-specific topics. This course covers the drilling side of horizontal wells. For the reservoir and production side, the companion course *Horizontal Wells: Reservoir and Production Aspects* (Dr. Erdal Ozkan) is recommended.

Course Outline

1. **Introduction to Directional and Horizontal Drilling**
   - Development of directional drilling
   - Drilling well types and applications
   - Horizontal wells and applications
   - The latest well types
   - Technical limits of directional drilling

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2. **Well Planning and Trajectory Calculations**
   - Trajectory of a well: definitions
   - Surveying
   - Directional trajectory methods
   - Horizontal well plans
   - Azimuth reference systems and interferences
   - Weight definitions in directional and horizontal drilling
   - Torque & drag, and buckling
   - Wellbore friction factor and its minimization, pipe oscillation (Slider)
   - Horizontal drilling hydraulics
3. **Directional Guidance Systems and LWD**
   - Sensor packages, pulse and electromagnetic telemetry
   - Operational and economic concerns in selecting MWD/LWD
4. **Downhole Motors, Power Sections and Lower-End Components**
   - Motor performance curves
   - Motor & bent-housing selection calculations
   - Steerable vs. non-steerable assemblies
   - Fixed vs. articulated motors (extreme short radius)
   - Hole size and casing selection fundamentals
   - Rotary steerable systems and applications
5. **Drill Strings for Horizontal Drilling**
   - High-strength drill pipe (DP)
   - Horizontal drilling DP connections
   - Non-magnetic drill collars
   - Other drill string components
   - Bits for horizontal drilling
6. **Horizontal Drilling Operations**
   - Kick-off: new drill or re-entry
   - Casing exit methods
   - Kicking off, time drilling and building the curve
   - Magnetic and gravity steering
   - Differential drilling and tool-face control
   - Projections to bit and to the target
   - Example of building and landing the curve
   - Target tracking / geosteering while drilling the lateral
   - Sidetracking